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METHODS OF TEACHING COMBINATORICS PROBLEMS IN PRIMARY SCHOOL

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Abstract:
This article discusses the methodological foundations of teaching combinatorial problems to primary school students and highlights the importance of such problems in developing students' logical, creative, and mathematical thinking. The article analyzes the possibilities of developing students' skills in combining objects and phenomena in different ways, systematically identifying possible options, comparing and generalizing them, and drawing independent conclusions through the use of combinatorial problems in primary mathematics education. Methodological recommendations are also provided on gradually increasing the complexity of combinatorial problems, starting with simple practical tasks and using tables, diagrams, tree diagrams, and modeling techniques.

Keywords: Combinatorics, combinatorial problems, primary education, mathematics lessons, logical thinking, mathematical thinking, problem solving, modeling, table, diagram, tree diagram.

Introduction

One of the important tasks of modern primary education is not only to provide students with ready-made mathematical knowledge, but also to teach them to think independently, analyze problems, search for different solutions, and justify their conclusions. From this perspective, the use of logical and combinatorial tasks in mathematics lessons is of particular importance.

Combinatorics is a branch of mathematics that studies ways of selecting, arranging, and combining different objects according to certain conditions. It is not necessary to introduce primary school students to the complex theoretical concepts of combinatorics in their complete form. However, developing elements of combinatorial thinking through simple problems can be an effective means of developing students' mathematical thinking.

In primary school, combinatorial problems are often presented through situations that are close to students' everyday lives. For example, determining different ways of choosing clothes from several items, forming different pairs using colored pencils, creating different

numbers from given digits, or selecting meals in different ways allows students to naturally understand combinatorial relationships.

The Importance of Combinatorial Problems in Primary Education

The main characteristic of combinatorial problems is that their solution often cannot be limited to performing a single mathematical operation. Students need to identify the available possibilities, organize them, and make sure that all possible options have been considered.

Such problems develop the following skills in students:

-logical thinking;
-independent decision-making;
-systematization of possibilities;
-comparison and classification;
-observation and analysis;
-generalization;
-mathematical modeling;
-searching for multiple solutions to a problem;
-mathematical justification of ideas.

Combinatorial problems encourage students to ask not only “Which operation should I perform?” but also questions such as “What other possibilities are there?”, “Have I found all the options?”, and “Have I repeated the same option?”

Types of Combinatorial Problems in Primary School

Combinatorial tasks used in primary education can conditionally be divided into several groups.

1. Problems Involving Pairs and Combinations

For example:

Problem. Ali has 3 shirts and 2 pairs of trousers. In how many different ways can he choose one shirt and one pair of trousers?

Students can determine all possible combinations using a table or picture:

	Trousers 1	**Trousers 2**
Shirt 1	Option 1	Option 2
Shirt 2	Option 3	Option 4
Shirt 3	Option 5	Option 6

Thus, there are **6 different options**.

Through this problem, students practically understand that every element of one group can be combined with every element of another group.

2. Simple Problems Involving Permutations

For example:

Problem. Anvar, Dilshod, and Madina are participating in a competition. In how many different orders can they occupy three places?

Students can list all possible arrangements:

-Anvar – Dilshod – Madina;
-Anvar – Madina – Dilshod;
-Dilshod – Anvar – Madina;
-Dilshod – Madina – Anvar;
-Madina – Anvar – Dilshod;
-Madina – Dilshod – Anvar.

Therefore, there are 6 possible arrangements.

At the primary school level, it is appropriate to explain such problems through practical counting and diagramming rather than through formulas.

3. Problems Involving the Formation of Numbers from Given Digits

For example:

Problem. How many three-digit numbers can be formed using the digits 1, 2, and 3 without repeating any digit?

Students can systematically write the numbers:

123, 132, 213, 231, 312, 321.

Thus, 6 three-digit numbers can be formed.

Such problems not only develop combinatorial thinking but also reinforce students' knowledge of numbers and place value.

4. Selection Problems

For example:

Problem. There are 4 types of fruit: apples, pears, bananas, and oranges. In how many ways can two types of fruit be selected?

Students identify all possible pairs:

-apple and pear;
-apple and banana;
-apple and orange;
-pear and banana;
-pear and orange;
-banana and orange.

Thus, there are 6 ways to make the selection.

Stages of Teaching Combinatorial Problems

When teaching combinatorial problems in primary school, it is important to follow the principles of consistency and gradual progression.

First Stage — Practical Manipulation with Objects

At the initial stage, students are given tasks involving real objects. Different colored pencils, geometric shapes, cards, pictures, or other concrete materials can be used.
Students combine the objects and determine the possible arrangements or combinations through practical activities.

Second Stage — Pictures and Modeling

At the next stage, real objects are replaced by pictures or conventional symbols. This supports students' transition toward more abstract thinking.
For example, students may be asked to arrange red, blue, and green balls in different orders.

Third Stage — Using Tables and Diagrams

As the number of possibilities increases, it becomes more difficult to determine all options simply by counting them one by one. Therefore, students should be taught to construct tables, diagrams, and systematic lists of possibilities.

Fourth Stage — Using Tree Diagrams

Tree diagrams are an effective tool for explaining combinatorial problems. Each choice is connected to subsequent choices.
For example, if there are 2 types of headwear and 3 types of clothing, each type of headwear can be connected to three clothing options. In this way, students can visually determine the total number of possibilities.

Effective Methods for Teaching Combinatorial Problems

The "Counting Possibilities" Method

This is one of the simplest and most appropriate methods for the initial stage. Students identify all possible options one by one.
An important requirement is to avoid repeating the same option and to ensure that no possibility is omitted.

The "Table" Method

Tables can be used to combine elements from two or more groups. This method is particularly effective for problems involving clothes, meals, means of transportation, and other everyday situations.

The "Diagram" Method

Information from the problem is represented using conventional symbols. This allows students to understand the relationships presented in the problem more clearly.

The "Tree" Method

As the number of possibilities increases, a tree diagram becomes an effective method. Each branch represents a new possibility.

The "Problem Situation" Method

Instead of providing students with a ready-made algorithm, the teacher presents a problem situation:

"How can we find all the possibilities quickly and without making mistakes?"

Students propose their own methods. The teacher then compares these methods and identifies the most convenient and systematic approach.

The Use of Didactic Games

Didactic games can increase students' interest in learning combinatorial problems.

For example, in the **"How Many Ways?"** game, students may be given 3 different colored pencils and 2 different notebooks and asked to determine how many different pairs can be formed.

In the **"Make a Number"** game, students are given cards containing different digits and asked to form numbers according to specified conditions.

In the **"Who Can Find It Faster?"** game, groups are given the same combinatorial task. The group that identifies all possibilities correctly and systematically is declared the winner.

Such games help students develop not only mathematical knowledge but also the ability to work collaboratively, exchange ideas, and justify their solutions.

The Teacher's Methodological Approach

When teaching combinatorial problems, the teacher should follow the following methodological requirements:

1. Select problems appropriate to students' age and level of knowledge.
2. Initially use practical and real-life situations.
3. Organize problems from simple to complex.
4. Teach students to identify possibilities systematically.
5. Use tables, pictures, diagrams, and tree diagrams.
6. Focus on understanding the essence of the problem rather than memorizing ready-made formulas.
7. Provide opportunities to solve the same problem in different ways.

8. Create conditions for students to think independently.
9. Analyze the causes of students' mistakes rather than simply correcting them.
10. Encourage students to explain and justify their solutions.

Increasing the Complexity of Combinatorial Problems

Problems should gradually become more complex. For example, if students initially form combinations from two objects, they can later be asked to work with three or four objects. Tasks can also be made more complex by adding the following conditions:

-allowing or not allowing repetition of objects;
-requiring a particular object to be included;
-requiring objects to be arranged in a specific order;
-prohibiting certain combinations;
-selecting only those options that satisfy a given condition.

For example, the following progression can be used:

"How many two-digit numbers can be formed using the digits 1, 2, 3, and 4?"

Then additional conditions can be introduced:

"The digits must not be repeated."
"Form even numbers."
"The digit 2 must be included."

This approach broadens students' thinking and teaches them to analyze the conditions of a problem more deeply.

Conclusion

Teaching combinatorial problems in primary school expands the developmental potential of mathematics education. Such problems not only strengthen students' mathematical knowledge but also contribute to the development of their logical and creative thinking.

When teaching combinatorial problems, it is effective to gradually move from real objects to pictures, tables, diagrams, and tree diagrams. It is important to develop students' abilities to count possibilities systematically, avoid repetitions, consider all possible options, and justify their solutions.

The use of didactic games, problem situations, and group work also increases students' interest in combinatorial tasks. Most importantly, combinatorial problems in primary education should not be viewed merely as a means of teaching complex mathematical formulas, but as an effective methodological tool for teaching students to explore, think, identify possibilities, and draw independent conclusions.

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